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Reliability Study on Control Methods for Hybrid Energy Storage Systems

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One important topic in simulation-based design under uncertainty is reliability. It is believed that the influence of control methods on the reliability of hybrid energy storage systems (HESSs, e.g., batteries and ultra-capacitors), which are the key components in hybrid electric vehicles, can be significant. Well-designed control methods of HESSs can help achieve the purpose of taking the advantages of different storage units in reliability point of view. This paper assesses five HESS control methods and presents a comparison study on their influence on reliability. Our work overcomes the shortcomings of the traditional reliability calculation by considering battery reliability in three discharging current ranges based on the five control methods. The system reliability is derived by comprehensively considering the reliabilities in different current ranges. Simulation results verify the theoretical reliability derivations. The results of this paper can be used in the design and the performance evaluations of HESS control algorithms.

Keywords: reliability, control methods, hybrid electric vehicles, HESSs